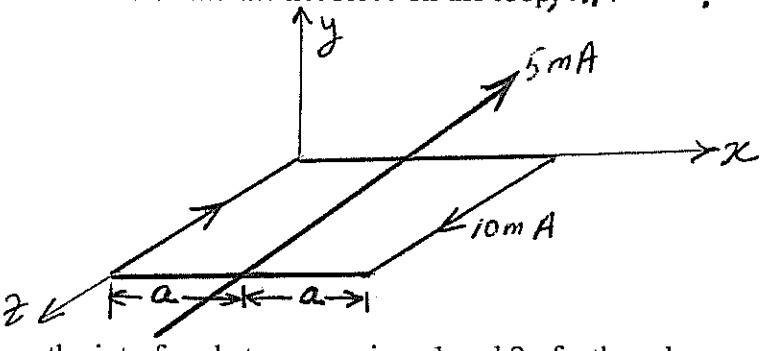
Problem 1

The square loop shown in the figure is carrying a current 10mA and is bisected by a very long straight conductor which carries a current 5mA. Find the net force on the loop, in 10^{-12}.

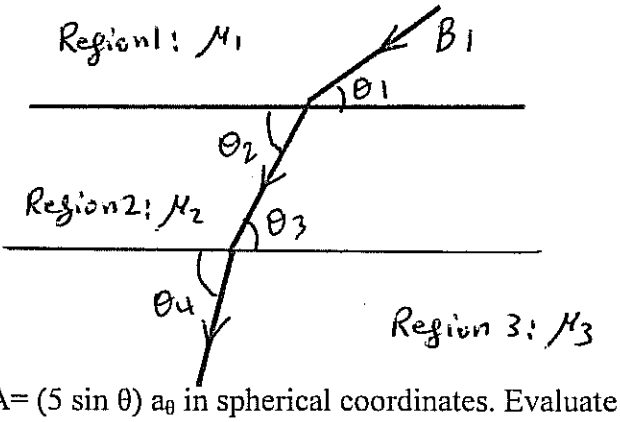
a. $20\ a_x$ N
b. $5a\ a_x$ N
c. $40\ a_x$ N
d. $10a\ a_x$ N
e. None of the above



Problem 2

Magnetic flux impinges at angle θ_1 on the interface between regions 1 and 2 of a three layer medium, characterized by permeabilities μ_1, μ_2 and μ_3 as shown in the figure. Evaluate the angle θ_4.

a. $\tan\theta_4 = (\mu_2/\mu_1)\tan\theta_2$
b. $\tan\theta_4 = (\mu_1/\mu_3)\tan\theta_1$
c. $\tan\theta_4 = (\mu_1/\mu_3)\tan\theta_3$
d. $\tan\theta_4 = (\mu_3/\mu_1)\tan\theta_1$
e. None of the above



Problem 3

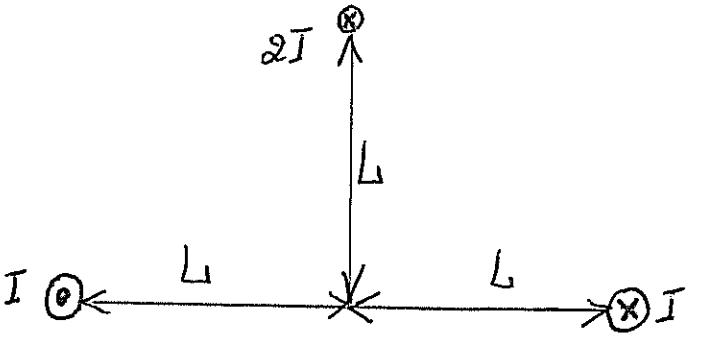
Given the magnetic vector potential $A = (5\sin\theta)\,a_\theta$ in spherical coordinates. Evaluate the B-field at the point $(5, \pi/2, 0)$.

a. a_y
b. $\sqrt{2}\,a_x$
c. a_θ
d. a_x
e. None of the above

Problem 4

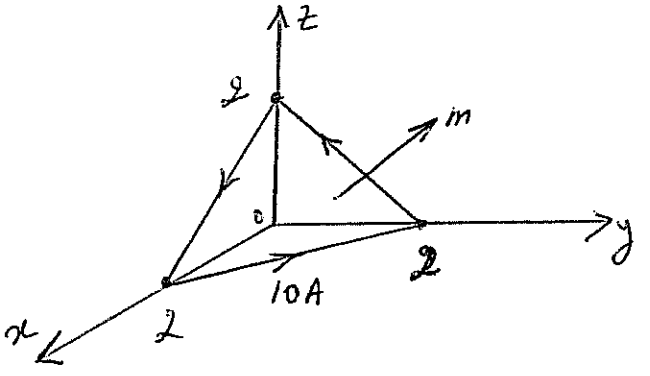
Three long wires, parallel to each other, are located as shown in the figure. The currents carried by these wires are also shown in mA. Assuming that the top wire is L meters long, determine the force experienced by it due to the fields of the two bottom conductors.

a. $0.4\ I^2$(N)
b. $(0.4/\pi)\ I^2$(N)
c. $\mu_0\ I^2$(N)
d. $(4\ \mu_0/\pi)\ I^2$(N)
e. None of the above



Problem 5

Consider the triangular loop lying on the plane x+y+z=2 and carrying 10A as shown. Determine the magnetic moment of the loop.



a) 10 $(a_x + a_y + a_z)$ A.m^2
b) 20 $(a_x + a_y + a_z)$ A.m^2
c) $(20/\sqrt{3})$ $(a_x + a_y + a_z)$ A.m^2
d) $(20.\sqrt{3})$ $(a_x + a_y + a_z)$ A.m^2
e) None of the above

Problem 6

In problem 5, the coil is now surrounded by a uniform field $(0.6a_x + 0.4a_y + 0.5a_z)$ T. Determine the torque on the loop.

a) $3\vec{a}_x + 5\vec{a}_y - 2\vec{a}_z$
b) $2\vec{a}_x + 2\vec{a}_y - 4\vec{a}_z$
c) $-6\vec{a}_x - 0.4\vec{a}_y - 4\vec{a}_z$
d) $2\vec{a}_x - 4\vec{a}_y - 4\vec{a}_z$
e) None of the above

Problem 7

Given that $H_1 = -2a_x + 6a_y + 4a_z$ A/m in region $y-x \leq 2$ where $\mu_1 = 5\,\mu_0$. Calculate H_{1t}.

a) $-2a_x + 2a_y + 4a_z$ A/m
b) $2a_x + 2a_y + 4a_z$ A/m
c) $2a_x + 4a_y + 4a_z$ A/m
d) $4a_x + 2a_y + 6a_z$ A/m
e) None of the above

Problem 8

The region $y-x \geq 2$ in problem 7 is characterized by $\mu_2 = 2\,\mu_0$, find B_{2n}.

a) $-10a_x + 10a_y$
b) $-30a_x + 20a_y$
c) $-20a_x + 20a_y$
d) $-15a_x + 25a_y$
e) None of the above

Problem 9

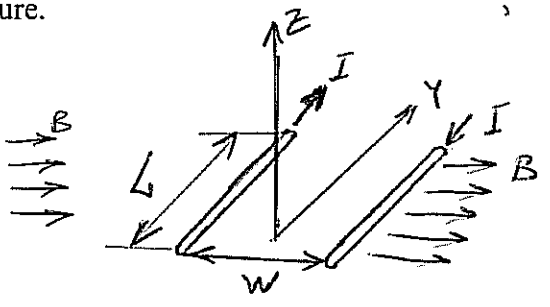
A radial field $H = \frac{2.39x10^6}{r}\cos\phi\, a_r$ A/m, exists in free space. Find the magnetic flux crossing the surface defined by $-\pi/3 \le \Phi \le \pi/2$, $0 \le z \le 1$ m.

a. 2.51
b. 6.73
c. 4.12
d. 5.58
e. None of the above

Problem 10

Find the torque about the y-axis for the two conductors of length L, separated by a fixed distance W, in the uniform field B shown in the figure.

a. B I LW ($-a_y$)
b. 0.5 B I LW ($-a_y$)
c. 2B I LW (a_y)
d. B I LW (a_y)
e. None of the above



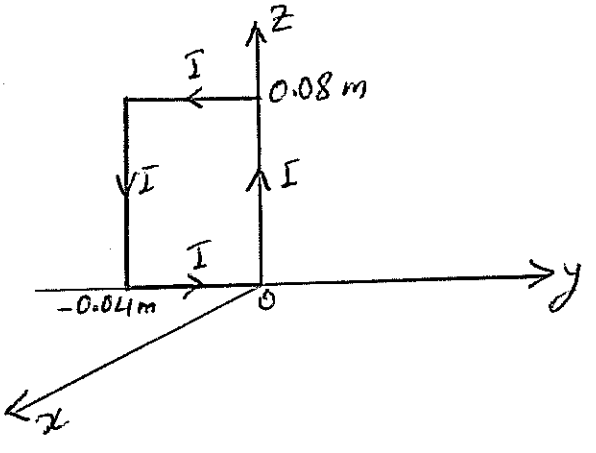
Problem 11

The rectangular coil in the figure shown is in a field

$$B = 0.05\frac{a_x + a_y}{\sqrt{2}}\text{ T}$$

Find the torque about the z-axis when the coil is in the position shown and carries a current of 5 A .

a. $3.67x10^{-4}$ a_z N.m
b. $5.66x10^{-4}$ a_z N.m
c. $7.24x10^{-4}$ a_z N.m
d. $1.21x10^{-4}$ a_z N.m
e. None of the above



Problem 12

In problem 11, at what angle should the loop rotate relative to the position shown in the figure shown in problem 11, to have the torque produced equal to zero?

a. 30°
b. 45°
c. 60°
d. 90°
e. None of the above